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RESEARCH ARTICLE

International Characteristics of the Macro-Logistics System of Freight Villages

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Abstract

This study of the international characteristics of the macro-logistics system of freight villages is a first overview of the subject, which has not previously been available. The study is divided into four parts. The first part describes the empirical method of the study and introduces the databases which were set up. The second and most relevant part deals with the different continents and their logistics sectors. The "Classic" and "Challenger" countries of the continents in the field of logistics have also been identified on the basis of the "Logistics Performance Index 2014" from the World Bank. A comparison between the single continents makes up the third part. The final part introduces selected outstanding locations which were found during the research. In addition, the study can provide support for various actors (for example, logistics real estate developers) in opening up new markets.

Keywords

freight village, dry port, macro logistics concept, hinterland, intermodal terminal

1 Literature review

An increase in sea freight flows generates an almost proportional increase in inland freight flows, and what takes place inland will influence the ability of intermodal transport systems to further accommodate the growth of international trade. This growth could be facilitated by dry ports, which have been developed to support seaport operations as well as the overall operations of intermodal transport systems (Rodrigue and Notteboom, 2009; Hanaoka and Regmi, 2011; Bask et al., 2014). The development of intermodal transport requires transport links, nodes, and services. The development of dry ports, an important component of intermodal transport, could play a major role in promoting this form of transport (Hanaoka and Regmi, 2011).

Nowadays, a port's potential hinterland can be defined as the area that can be reached at a cheaper cost or in a shorter time than from another port. As a result, hinterlands overlap. Therefore ports and carriage providers compete to service locations in these overlapping segments. With the advent of inland terminals, inland ports and dry ports, hinterlands now extend even further inland, adding to the complexity of the analysis of port economics and logistics activities (Lee et al., 2008; Roso et al., 2009; Wilmsmeier et al., 2011). The management and expansion of the port hinterland is at the core of ensuring the competitiveness of modern ports (Shi and Li, 2016).

More recently, the term dry port has been used in the industry as a marketing tool, perhaps to imply that an inland facility has reached a particular level of sophistication in terms of services offered, such as customs or the presence of Third Party Logistics (3PL) firms within the site and/or an adjoining dry port or similar (GVZ (Güterverkehrszentren) in Germany, ZAL in Spain, Interporti in Italy) (Wilmsmeier et al., 2011). In Germany, however, a dry port is usually referred to as an inland cargo village. Dry ports, as nodes in transport networks, have been developed, among other reasons, to support seaport operations and the sustainable development of international intermodal transport chains, or links (Hanaoka and Regmi, 2011; Roso, 2013; Kovacs and Kot, 2016). Dry ports could make goods handling more efficient, and shifting freight volumes from road to rail (between port and dry port) could result in a lower environmental impact. In

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line with this, (Roso, 2013) claims that the construction of dry ports near strategic urban locations can help reduce the number of freight trips. The emergence of dry ports (offshore ports) is driven partly by proximity to main population centres or industrial areas and partly by the need to support rapidly growing container flows (Beresford et al., 2012; Ślusarczyk, 2017).

The dry port concept is based on moving intermodal terminals further into the hinterland from the port areas. This helps to avoid traffic bottlenecks, to connect cargo handling from the port with other types of cargo at one common transport centre, and it can also help develop the hinterland areas themselves (Jaržemskis and Vasiliauskas, 2007). Dry ports in the original discussion were generally developed from the landside towards the sea, a requirement resulting from these locations being landlocked or otherwise suffering from poor maritime access (Wilmsmeier et al., 2011). It was noted in the literature review that early dry port definitions referred to landlocked (or poorly-connected) countries using the terminal as a maritime access point. Since then, the term has been used in various ways, but without clear definition (Monios, 2011).

The development of dry ports, an important component of intermodal transport, could play a major role in promoting intermodal transport (Hanaoka and Regmi, 2011). Development of dry ports reduces customs costs, improves rail-sea intermodal capacity, and minimizes transportation time (Ng and Cetin, 2012; Wang et al., 2016). As a rule, dry ports are located along developed transport corridors (Panova and Hilmola, 2015). Dry port location planning requires a thorough decision making process as it is too costly to relocate the facility in the short term. Many models used for facility location attach a substantial role to transport costs when searching for the optimal location (Nguyen and Notteboom, 2016). Usually located at strategic places near gateway seaports, industrial areas or along major transportation axes, dry ports play significant roles in optimizing all activities to ensure cargoes can be delivered from one end to another in an efficient manner (Juhel, 1999). Furthermore, as proposed by (Azcárate, 2007), in the design of a methodology for the location of an wanted plant, a series of steps are carried out: 1. Exclusion phase: define a set of exclusion criteria, 2. Definition phase: the definition of a set of factors that allow us to measure the adequacy of the different locations that have passed the previous restriction criteria and 3. Selecting assessment phase. The results (Awad-Núñez et al., 2014) give greater importance to the aspects considered in the classical theories of industrial location. However, establishing the most appropriate location for a dry port is a geographical multidisciplinary problem with significant economic, social and environmental implications. Conventional notions of port choice have focused on geographical location as one of the main determinants of a port's attractiveness. The choice of a port is not merely a function of proximate convenience, considerable implications are also derived from the overall transit costs of cargo trafficking. For example, the distance between the port and the

port user's premises has a major impact on inland transportation costs (Tiwari et al., 2003; Kot, 2015).

More particularly, the port function contributes to increased business activity, which is specialized in the shipping and transport services, while enhancing the business activity associated indirectly with this (banks, insurance companies, tourist agencies) (de Langen, 2004) and giving the opportunity to relevant stakeholders to invest (Dooms et al., 2015). Thus, dry ports, in accordance with the above, are catalysts of economic growth and employment creation (Jung, 2011) favouring the globalization process. The organizational environments might be changing at an increasing rate and becoming more and more unpredictable as part of a global trend towards increasing complexity and uncertainty in business and economic environments, they can still at least develop and work towards long-range organizational objectives (Koopman et al., 1999).

2 Methods

Part One: Empirical Method

Deriving an all-embracing definition of a dry port is difficult as the role of a dry port varies from country to country and from region to region; dry ports also vary in scale, complexity and area of specialism (Garnwa et al., 2009).

At the beginning of the data collection a list was created with the help of the previously developed working definition to which synonyms concerning the word “freight village” were added. For example, the terms Interporto, which is used as a synonym in Italy, and Logistics Park or Platform, which is used in different countries (Table 1).

Table 1 Thesaurus freight village technical terms

“Country specific names”	“General names”
<ul style="list-style-type: none"> • Centro de Transport (e.g. Spain) • Distripark (the Netherlands) • Free Zone (FZ) (Serbia, Croatia) • Freight Village (FV) (Europe/UK) • Güterverkehrszentrum (GVZ) (Germany) • International Logistics Centre (LC) (Uzbekistan) • Interporto (Italy) • Platforms Multimodales/ • Logistiques (France) • Plaza Logistica (PL) (Spain) • Special Economic Zone (SEZ) (e.g. Iran) • Transport Center (Denmark) • Zona de Actividades Logísticas (ZAL) (Spain) 	<ul style="list-style-type: none"> • Freight Village • Dry Port • Freight Gateway (FG) • Freight International Facilities (FIF) • Industrial Zone • International Logistics Centre (LC) • International Node • Logistics Base • Logistics Cluster • Logistics Hub • Logistics Zone (LZ) • Multimedial Terminal • Nodal Centers for Goods • Special Economic Zone • Zona Franca

Source: Authors' own research

The list was continually expanded during data collection and divided into “Country specific names” and “General names” (Table 1). “Country-specific names” are terms that are

common in a country, such as “Centro de Transport” in Spain. The “general names”, on the other hand, include synonyms that occur in different countries. As an example, the term “industrial zone” can be mentioned here. The thesaurus is used to facilitate the search for locations outside Germany.

At the beginning of the study the authors elaborated a definition for freight village locations which were integrated in the study. To figure out the right definition and the characteristics of freight villages, different definitions were compared and the concept of freight village was differentiated from similar concepts, such as dry ports. The final definition of freight villages is the following:

- A macro-logistics hub (freight village in Germany) is a **defined area** in which logistics- and commercially intensive companies, logistics service providers, complementary service facilities and traffic economic enterprises are settled as **independent companies**.
- In the case of **intermodality** the area has to be connected at least to the **transport mode road/railway**.
- The freight village should have a **transshipment facility** for combined road and railway transport, or should be located near a transshipment facility. The facility needs to be non-discriminatory and available for all settlers.
- The location **is not necessarily** required to be close to a **port**.
- A **management organization** for the management of the area would be **preferable** but is **not obligatory**.

After characterizing a freight village the next phase was the literature research. Literature was used from databases such as Factiva and from libraries such as the ISL Info center/library and the Staats- und Universitätsbibliothek Bremen (SuUB). All relevant information about locations of freight villages around the globe were collected in an exclusive “Location

Database”. This database consists of two areas. The first area comprises information concerning the literature which was used for the data on the locations. The second area shows the data from the literature. The database is sorted by continent and further by country. At the end of the Location Database the single locations were summarized to acquire an overview of the locations identified (Table 2-3). The final database established comprises important institutions, for example real estate development companies such as ProLogis, or transport infrastructure managers such as SNCB Logistics in Europe.

The second location-related area contains information on various criteria and aspects, such as the name of the location, the type of location, the area, the modality, as well as the number of companies, employees, and services, and other characteristics.

The type of the location can be divided into the following categories: FV/GVZ, multimodal logistics center, dry port, unimodal logistics center, logistics center or intermodal terminal. In the location database, the two areas are located side by side, so that the relevant information is also visible.

There is an initial summary complementing the recorded locations, with an indication of how many of the recorded locations can be identified as GVZ at the end of each country survey (Table 4). For each country, the total number of locations covered is indicated. This includes the number of the locations that are currently being planned.

After the individual locations had been recorded, they were filtered. The filtering was carried out using the definition at the beginning, in order to filter the GVZ locations at all locations in the database. The criteria for filtering for GVZ locations included the following five: modality, intermodal terminal, independent company settlement, service facilities, and moderation function. With respect to the operator/modality, a connection to roads as well as to rail was important. Likewise,

Table 2 Location Database (extract)

Country	Location	Title/ Web link	Author	Year	Keyword
Germany	Bremen	Entwicklung der GVZ in Deutschland 2012	Deutsche GVZ-Gesellschaft mbH	2012	
Germany	Bremen	http://www.gvz-bremen.de/	WFB Wirtschafts-förderung Bremen GmbH	4.10.2014	freight village
Number of locations in Germany		38			
Planned Locations		2			
Number of FVs		35			
United Kingdom	London	http://www.londongateway.com/	London Gateway	4.11.2013	logistics park

Source: Authors' own research

Table 3 Location Database (extract)

Name of location	Type of location	Area (in ha)	Modality	Number of companies	Employees
FV Bremen	FV	503 ha	Road/ Railway/ Water	146	8.000
GVZ JadeWeser-Port	FV	160 ha	Road/ Railway/Water	21	N.A.

Source: Authors' own research

companies and service providers should be located in the immediate vicinity of the transfer facility. In addition to the companies and service providers and their services, additional services, such as petrol stations or catering facilities, should also be available for all open-ended services. For better coordination between companies and service providers as well as within the location, a management company that takes on a moderation function is an advantage. After filtration of all locations (over 700), approximately 40% (over 300) were identified as GVZ locations (Table 4).

Table 4 Recorded locations

Germany	Bremen	Bremen	Development
Number of locations in Germany	38		
Of which GVZ-locations	35		
Number of locations in Europe	336	Total number of locations in the world	735
Of which GVZ-locations	236	Davon GVZ-locations	329

Source: Authors' own research

Second Part: Overview of global freight village locations

The overview of global freight village locations is divided into continents. The structure of the subdivisions is similar. First, an overview of the general logistics sector is given and afterwards this is specified in the field of the freight village locations in selected countries. At the end of each subdivision an extract is made of freight village locations. The countries were selected by their rank in the Logistics Performance Index. The three best countries, as well as the three strongest growing countries, were chosen. **The best countries are classified as “Classic” and the three strongest growing countries as “Challenger”.**

The **Logistics Performance Index (LPI)** is an interactive worldwide benchmarking tool. It can help countries to identify the challenges and opportunities they face in their performance on trade logistics and what they can do to improve their performance. The LPI 2014 comprises and compares 160 countries. The LPI is based on a worldwide survey of 6,000 logistics operators. Within the survey there were six characteristics which were assessed. The characteristics are divided into two groups: The first group comprises the area of strategic activities such as customs clearance, infrastructure performance and the level of service. The second group deals with the service performance (outcome). Characteristics of this field are tracking and tracing, reliability and punctuality, as well as international shipment. The single characteristics were summed to create an aggregated indicator to evaluate them with a standardized statistical technique. The range is from 1 (worst) to 5 (best) (Arvis et al., 2014).

3 Results

3.1 Africa

The economic situation of Africa varies between the individual countries. The reasons for this are on one hand the topographical conditions, and on the other hand the level of political stability. One important remark is that the countries in the north of the continent are growing faster than those in the south, excepting South Africa, which is a comparatively developed country.

Countries identified as **“Classics”** in Africa are **South Africa, Morocco and Egypt** which were ranked in the Top 70 of the LPI (Arvis et al., 2014).

The strongest **“Challengers”** are **Nigeria, Rwanda and Algeria** which were ranked in positions 75, 80 and 96. The infrastructure of the “Classics” and “Challengers” are well developed and feature a sustainable network of roads and waterways. Railways are under construction and because of this combined transport is in its initial stages. To prepare for future competition the **“Classics”** and the **“Challengers”** will invest more in infrastructure and the development of logistics networks.

In Africa there are some freight village-type locations but they differ from European freight villages. In Europe the FV locations are on the outskirts of cities while the FV in Africa are integrated in city planning. The FV are part of the “Industry City”. In Africa waterways are important so the cities are near harbors and so near to waterways. Through the neighbourhood of the harbor the location can challenge the global competition. The advantage of such a concept is the proximity of different sectors such as transport and production.

3.2 Asia

The infrastructure network is well developed in Asia. Furthermore, to compete in the field of logistics a harbor is important because a significant proportion of the transport volumes are handled through waterways. The **“Challengers”** in Asia are **Qatar, Indonesia and Armenia. Singapore, Japan and China** are the **“Classics”**.

It is important to note that the **“Classics”** do have harbors and are good performers in the field of logistics. It is also necessary to have a well-developed infrastructure through which goods can be carried easily. These aspects are clearly evident when considering the **“Challenger”** Qatar. The country invests in the development of infrastructure and in the simplification of goods movement. This is one reason why Qatar is getting stronger in the field of logistics and is attempting to become a **“Classic”**. Beside a well-developed infrastructure it is also important that some international logistics service providers are established, in order to gain more revenue. In Singapore, China and Japan important international logistics service providers like DHL or Kuehne + Nagel are present. If we compare China and Japan with Qatar it might seem Qatar does not have that many international logistics companies. One reason for this is the slow

opening up of markets for foreign companies and shareholders. Most Asian logistics facilities could not be identified as FV according to European standards. This occurs because logistics locations are connected to only one transport mode, or they are part of the harbor. Combined transport between road and railway is in most cases relevant for Dry Ports.

3.3 Europe

Germany, the Netherlands and Belgium count as *“Classics”* and Turkey and Hungary are the *“Challengers”*.

In Europe it is important to have well-developed and modern infrastructure as well as a nationwide network over all four transport modes. Both of the *“Challengers”* - Turkey and Hungary - have invested a lot in their infrastructure and so they have performed better in the LPI and can become top logistics locations if they make further positive developments. Beside well-developed infrastructure it is important to build up logistics facilities for importing and exporting, consolidating and handling goods.

3.4 North America

The infrastructure in the northern countries of North America is well-developed and there is an efficient multimodal transport network over most of the continent. The countries in the southern region have also a well-developed transport system and they strengthen the trade between Europe and Asia through their Gateway function. This is made possible by important waterways like the Panama Canal. The *“Classics”* in North America are the **United States of America (USA)**, **Canada** and **Mexico**. The *“Challengers”* which have grown fast in recent years are **Panama**, **Nicaragua** and the **Dominican Republic** (Arvis et al., 2014).

The freight village locations in North America vary. Whereas the northern region has a widespread network of intermodal locations, in the southern countries there are only a few single FV locations. However, the locations in the south are more often managed by a holding company than those in the north. One example of a holding company is the “Corporación de Zonas Francas” in Nicaragua.

3.5 Oceania

In Oceania there are only two large countries, so there are no *“Classics”* and *“Challengers”*. The countries which were considered in this study are **Australia** and **New Zealand**, both of which have well-developed economies. New Zealand depends on trade in sheep’s wool. A unique feature of the transport sector in Australia are the so called “Road Trains”, which have trucks up to 53.5 m long. For comparison, a German truck is only 18.75 m long.

In the field of logistics facilities there are some individual approaches which can be identified as freight villages. The difference between Australian and New Zealand facilities lies in

the size of the FV areas. In Australia the facilities cover a total area of 70 ha and are limited in their transport activities. In New Zealand the total area is about 500 ha and they include housing compounds for employees, as well as transport related activities.

3.6 South America

On the basis of the LPI the *“Classics”* in South America are **Chile**, **Argentina** and **Brazil**. **Venezuela**, **Paraguay** and **Peru** are the *“Challengers”*.

Most of the goods transport in South America is carried by road because the railway network is not very well developed. The countries with a small surface area try to be as attractive as larger countries. To achieve this they invest a great deal in the infrastructure in order to attract foreign companies to invest in their country.

After an analysis of the facilities in these countries in terms of logistics interfaces, the results show that there are only a few intermodal locations and freight villages of European standard, and these are found in Chile and Brazil. All the other countries considered only have unimodal logistics parks.

Part three: Comparison between the single continents

After considering the single continents and their characteristics the continents are compared with each other. The focus of the comparison is on the characteristics of freight villages. Table 5 gives a short overview of the similarities and differences.

Table 5 Comparison between the single continents

Similarities	Differences
Connection to different modes of transport (Focus: Road/ Railway)	Number of settlements
Intermodal terminal for transshipment (Focus: Road/ Rail)	Service portfolio
Most of logistics related companies onsite the freight village area	Freight village financing and management model
Located near Conurbations	Size/Layout/Design

Source: Authors’ own research

One important similarity between all locations is the connection to different transport modes. All of the identified locations are connected to roads and railways. Some of the locations are further connected to waterways and/or airports. Furthermore, the freight villages have an intermodal terminal for transshipment between transport modes. Another similarity between all freight village locations is their position. They are located near conurbations so that they have access to important transport corridors, as well as to customers.

What differs between the locations is the number of freight village tenants. These numbers vary between a few and several hundreds, but all tenants are active in the logistics service sector or related logistics intensive industries. Due to the varying number of settlements, the size, layout and design

of the freight villages is different. In Europe, for example, locations include all important equipment such as intermodal terminals, parking zones, warehouses etc. On the other hand, in Africa and South America the locations also include housing areas for the employees, as well as leisure facilities. The employees work and live in the same district. Another difference lies in the service portfolio, particularly in terms of its control system. In Africa most freight village locations have an incoming and outgoing control system. In North America there are fences around the areas, while in Europe there is no fence and no incoming and outgoing control system. The final difference between the single continents is the freight village financing and management model. In Europe and Australia structures can often be found which focus on managing the area and strengthening the cooperation and collaboration between the settled companies. Other continents have no managing associations; firms organize their own activities and there is not that much cooperation and collaboration between them.

Part four: Special locations

There are three special locations which will be mentioned in the following section. The information provided on these locations is basic data.

The first location is the **Tokyo Ryutsu Center (TRC)** in Tokyo (Japan). It is located outside the city center and comprises a total area of 40 ha and consists of four buildings. The special characteristic at this location is the design or layout of the park, which is built like a parking garage. There are a variety of warehouses on each floor. The trucks drive onto their floor and load/unload their goods. Furthermore, there is a huge range of service facilities, including petrol stations, grocery stores, doctors, hairdressers, and so on. The TRC began operations in 1971.

The second location is the **London Gateway** in London (United Kingdom), which is located 30 km from London by the River Thames. The location will be developed so as to become the central logistics hub for Great Britain. It offers a Common User Facility (CUF) which can be used by a variety of firms at the same time. Operations began in 2013, and the London Gateway will be finished in 2020.

The third location is **GVZ JadeWeserPort** in Wilhelmshaven (Germany), which started operating in 2012. This location is the only deepwater port in Germany. The GVZ JadeWeserPort's connections are very good since it is connected to road, rail and water transport modes. Furthermore, it includes a port area and an industrial and logistics area, which is a unique approach in Germany.

4 Conclusions and recommendations

As already mentioned, this study can only be the first step towards a more comprehensive (i.e. more detailed) comparison of global freight village structures. In addition, the study can provide support for various actors (for example, logistics

real estate developers) in opening up new markets. Possible objectives / challenges that can contribute to further stabilizing the process begun by the study include permanent recording of further new sites and maintenance of corresponding databases, support for national freight village associations by providing appropriate data bases, as well as the creation of Key Performance Indicators (KPI), which specify the development and, above all, the performance of the sites. These include, for example, surface structure data, data on company settlements and employees, services in freight villages, building and land structures, management structures and their tasks, access to the transport modes, intermodal terminal services, and SWOT analyses. The development of a rough ranking, initially based on a few criteria, could assist in comparative analysis. These could help generate support for logistics real estate developers or logisticians in their (international) market analyses, and provide support for seaport operators / shipping companies in setting up / completing their hinterland network.

A major field for further study relates to the geographical and functional differences in terminalization strategies in terms of different supply chains and commodity flows (Rodrigue and Notteboom, 2009).

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